HD28
.M414
no.273-
67

WORKING PAPER
ALFRED P. SLOAN SCHOOL OF MANAGEMENT

MANAGEMENT, COMPUTERS, AND MARKET SIMULATION

273-67

SEP 15 1967

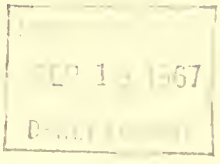
Arnold E. Amstutz

MASSACHUSETTS
INSTITUTE OF TECHNOLOGY
50 MEMORIAL DRIVE
CAMBRIDGE, MASSACHUSETTS 02139

MANAGEMENT, COMPUTERS, AND MARKET SIMULATION

273-67

Arnold E. Amstutz



H628
.M414
no 2755-67

RECEIVED
OCT 2 1967
M. I. T. LIBRARIES

MANAGEMENT, COMPUTERS, AND MARKET SIMULATION*

by

Arnold E. Amstutz
Associate Professor of Management
Sloan School of Management
Massachusetts Institute of Technology

The major portion of our discussion today has been very computer oriented. Phil has just described a Brave New World which he contends we shall attempt to cohabit with a vast array of automata in five or six short years. Makes one suspect that the top priority problem for all those computers to solve will be the machine population explosion.

The Management Role

As we turn to the subject of Computers, Management, and Market simulation it may be useful to shift our eyes momentarily away from the computer and to look at management. What will be the role of the manager in five years when, if Phil is correct, most companies will be applying computers and information technology to management problems?

The computer is the vehicle through which management can make use of models and data structures of great complexity and validity. But management must use the vehicle. Management must specify which measures are to be accumulated in the data file. Management must determine the scope and focus of system development. Management must insure that models given to the computer accurately reflect prevailing market conditions and incorporate relevant measures of executive action and market response.

Effective use of the computer is dependent on management's ability to adequately answer some very basic questions: Questions of priority, of criteria and measurement, of planning approaches, decision procedures, and standards of evaluation.

---

*A talk presented at "Marketing and the Computer", a Conference Presented by the American Marketing Association, New York Chapter, May 18, 1967.

05773285

Because of the computer it has become reasonable for management to ask, "How would we handle this problem if we had all the time in the world? Time to think, to analyze, to consider every conceivable approach to this situation." The computer's capability to quickly analyze large numbers of alternatives permits the well prepared manager to act as if he had "all the time in the world" to evaluate major problem situations. The computer, if effectively used, extends the productivity of available decision time. Achievement of this potential is not limited by existing computer hardware. It is dependent on management willingness to plan, to develop and test explicit criteria, to develop preprogrammed decision procedures, and to build models.

This afternoon we are concerned with management activity associated with a particular type of computer application. Market simulations are models. Or, more correctly, systems of models. When developing a simulation, management is called upon to specify measures and processes relating to market behavior and to management actions designed to influence that behavior. The models on which market oriented simulation systems are based frequently encompass microanalytic representations of retailer, distributor, salesman, and consumer or industrial purchaser behavior. Development of a market simulation involves management in a highly creative process through which they attempt to develop an artificial world which will duplicate response characteristics of a comparable real world market. Let me emphasize that <u>management</u> is involved in this process. If the resulting system is to contribute to planning and decision making, the planners and decision makers must insure that their insights, their perceptions, their priorities, their concepts, and their criteria are the basis for the system. This design responsibility cannot be delegated to system analysts or computer programmers.

Developing A Market Simulation

I would like to spend the majority of my time this afternoon discussing the process followed by a management intent upon communicating their objectives, criteria, and perceptions to a computer. We will be concerned with the development of a Microanalytic Market Simulation.

To illustrate this process I would like to describe a portion of the management interaction leading to definition of a food product market simulation. The actual development process encompassed several meetings over a period of approximately three months. The individuals involved in these meetings were the top level marketing management of the company -- the planners and decision makers who establish and control marketing policy and strategy within the firm. My role was that of Socratic scribe.

The first meeting opened with a question. "What do we want to simulate? How can we establish boundary definitions for a system? How much detail should the system encompass? What should be its scope?"

The Vice President for Production responded with the suggestion that, "it should certainly include our operation. After all, we make the product, it's a fine product, and ..."

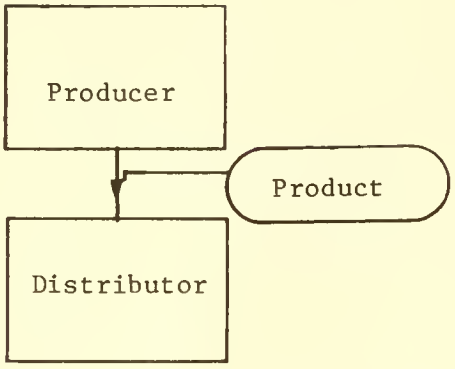
After some discussion of the relative merit of competitive offerings and the company's outstanding quality control program, I drew a large box and wrote "Producer".

"Is there anything else we should include in the system?"

"How about the distributors?"

"We make it. They distribute it."

I drew a second box connected to the first by a straight line and wrote "Distributor".



At about this point someone suggested that we called this meeting to define a model and I seemed to be spending the time drawing boxes. I asserted that we were, in fact, making real progress toward model development. We had now identified two important elements of the model; the company and its distributors.

With a few mumbled references to "sophomoric academics" the discussion continued until we had produced a flow chart description of the type illustrated in Figure 1. Government; retailer; distributor; consumer; and distributor-competitor- and company-sales forces were identified as major market elements. Interactions among these elements were described by lines representing product and information flow. At a later stage, basic cash flow relationships were also considered.

One often hears the assertion that it is impossible to model marketing relationships simply because "there are so many factors involved". The first objective of this process was to identify a limited number of elements and interactions. Much remains to be done. Much complexity will be added in later steps. The objective is not to deny complexity; but to establish a structure within which management can work with realistic complexities in an orderly and systematic way.

Once a "Macro Structure" of the type illustrated in Figure 1 has been established, attention can be focused on processes associated with each interaction point. Backlogs, delays, and transfer points at which the rate of product, information, or dollar flow may be measured are identified.

Returning to our company meeting, one of the managers was anxious to "make things more realistic". He suggested that we start by identifying key points in the distribution (product flow determined) system.

> "Those nice neat black lines have been bothering me. They make things look too simple. Now, let's take our manufacturing operation. Every time we get above a certain raw material inventory level our spoilage rate goes wild. We also have a problem with packaged product. Can't move it fast enough. Keep getting spoilage. On the other hand, whenever we try to back off on production the sales people start screaming about stockouts. The distributors have a real inventory control problem, and most of the retailers don't even know what inventory control is."

> "As far as the consumer is concerned, we ought to be spending some of that advertising money to get the consumer to buy only when he is ready to use. Some of our promotions have actually featured multiple package deals and I don't think the average customer gets through one container without a little mold starting to show up."

> "The point is these straight lines you're drawing just don't tell the whole story."

Through this process the initially simple system structure is expanded to encompass realistic complexity. Figure 2, for example, illustrates a product flow description developed to take account of the spoilage problem.

In a similar fashion, the previous "straight line" description of information flow was expanded to take account of advertising exposure and response. Five key steps in the response process were identified in the course of this discussion.

1. Exposure to a media type (e.g., news magazines).
2. Exposure to a particular ad in one medium of the type (e.g., Time Magazine).

3. Assimilation of the advertisement.

4. Change in awareness.

5. Acquisition of specific knowledge -- memory update.

Exposure to the media type was considered to be a function of consumer media habit. In this sense the marketing executive could do nothing to influence consumer media exposure. He could, however, select media offering high exposure probabilities for his target market.

Within the media type a particular medium(e.g., Time Magazine) was selected and a desired rate and frequency of presentation were established. The manager influenced consumer exposure probabilities for a particular advertisement by the extent and allocation of his advertising expenditures.

Management concluded that four factors determined consumer interest in and subsequent assimilation of a particular advertisement once exposure had occurred. These were:

1. The size or time extent of the advertisement.

2. The use of color.

3. Appeals communicated by the advertisement.

4. Consumer predisposition toward appeals content.

The consumer's ultimate response to assimilated communication was judged to be a function of:

1. Content described by communicated product characteristics and appeals.

2. Existing consumer predisposition.

3. The extent of brand identification in the promotion.

This process description is illustrated in Figure 3.

After interactions among elements had been described, major decision points associated with each element were identified. When examining the

manufacturer sector, the objective was to identify major decisions affecting actions taken in the marketing environment. This process followed naturally from the discussion of interaction relationships. Management was concerned with decisions affecting the rate, distribution, and content of media promotion; use of point-of-sale material; pricing; and sales force utilization.

Definition of key decision points associated with elements in the market environment was oriented toward decisions affected by the company and their competitors. These included trade channel decisions to order, inventory, place point-of-sale material, provide differential shelf space, advertise, and participate in various types of "deals".

This process of management specified system definition uncovered key points of dissention. One might argue, in fact, that if differences of opinion had not been encountered, the modeling process was probably insufficiently explicit.

Definition of major consumer decisions evoked substantial discussion. "There are millions of things that can happen at the consumer level and we can never ..."

> "We know we are getting media exposure. But we haven't a very good handle on response. We've got some ideas for measuring orientation change so our model should cover exposure to advertising, some kind of 'noting', and orientation change. We really need to tie this one down. We're spending 20% of gross on media and simply don't know what it's buying us."
>
> "We know one important thing about our consumers. There are two kinds. There is the one who makes a decision to go shopping. And, there is the one who gets accidentally exposed to the product while shopping for something else. If we're going to influence both types of customer, we need to know how they are affected by point-of-sale displays, retailer tie-ins, deals, and competition."
>
> "What we really need to know is what makes some people buy our brand, some people buy the competitor's, and some people never buy. The only decision that's really worth worrying about is the purchase decision."

"And after they buy we have to worry about how they like it. If they take it home and it turns green, they're not going to buy any more."

The key concept is explication -- specification of elements, management actions, distributor and retailer decisions, and consumer responses. Management is defining the market in terms which they consider relevant. Many assumptions are made. But, they are explicit assumptions.

Major elements of the manufacturer, retailer, and consumer decision structure established by this discussion are summarized in Figure 4.

Description of a Decision Process

Once decision and response elements had been identified, the discussion turned to factors influencing specific decisions and responses. Management's intuitive understanding of market processes was converted to explicit and testable behavioral models. Each decision and response point was examined. Relationships between inputs and observable behavior were formulated in terms of measures which permitted model validation against available market data.

As an example, let's consider one consumer decision point -- the decision to shop. Management has indicated that some consumers make a definite decision to shop for the product. The question now becomes, what factors influence this "decision to shop"? Which management actions and characteristics of the market place influence a consumer to go shopping for a product?

"Well, ... people who think they could use the product -- people who believe they have a need for it -- are most apt to go shopping. It's a matter of perception. People who have a high perceived need for the product will shop for it."

"Perceived need yields shopping. Fine. But how do you measure perceived need?"

"We have been using 'buying-intentions' data. We have interviewers going around asking people what they intend to purchase. Someone who has a high perceived need is going to say that they intend to go shopping. It doesn't make any difference whether they actually shop or not, it's their intentions that we're concerned with."

"Assuming that we use this perceived need concept, how do management actions affect an individual's perceived need?"

"Much of our advertising tells the consumer things he can do with our product -- makes him aware of all the opportunities he has to use it. This is a key idea. The more opportunity the consumer has and is aware of, the more apt he is to think he needs the product. Someone who is always giving cocktail parties has many more opportunities to use prepared hors d'oeuvres."

"Now wait a minute. That's not really true. There are quite a few folks around who have lots of opportunities to use our product. The problem is they have already had some of it and it turned green! And now they won't touch the stuff. Attitude is important here, too. We have to take into account how the customer feels about the product."

"We are forgetting something very basic. Someone who has already gone shopping and bought the product and has it in the refrigerator isn't going to want any more. Once someone owns it, he has no need to get more. We have to take into account the consumer's current supply of product."

"There is something else we forgot. There are many people around, probably the majority, who don't even know about the product. They don't know enough to know whether they like it or not. They aren't even aware of it."

Through this process management has developed a theory. In its initial forms, it is a rather qualitative theory. But with appropriate attention to measurement, it can be refined to an explicit set of equations.

The Perceived Need Concept -- An Example of Quantification

Management hypotheses regarding the decision to shop led to a qualitative concept of "perceived need". This concept which was initially expressed in terms of intention to buy might be viewed as an extension of utility theory. When formulating this model management proposed that the consumer's motivation to take action to acquire a particular brand is related to his perceived need for that brand which increases with:

1. Positive attitude toward the brand.
2. Opportunity for brand use.
3. Time since purchase.

The Effect of Attitude

Using a modified Osgood scale consumer orientation (attitude) toward a brand is measured by asking a respondent to rate the brand on an eleven point scale from +5 (strongly favor) through 0 (indifferent) to -5 (strongly dislike). The observed relationship between attitude (measured using the scale shown in Figure 5) and "Perceived Need" is illustrated in Figure 6.

Use Opportunity

Use opportunity is measured in terms of the number of times that the consumer had an opportunity to use a brand within the product class being studied during the preceding quarter. This information is obtained by direct interview as well as diary maintenance. As illustrated in Figure 7, a linear association was established between the use opportunity and perceived need measures.

Time Since Purchase

The time since purchase is measured, as the name suggests, by determining the time (in weeks, or average product life) since the consumer last purchased a brand in the product class being studied. Figure 8 illustrates the general form of this relationship expressed in multiples of average product life for the current perishable food product example.

Income Stratification

Initial attempts to validate the perceived need construct produced evidence that the relationship between the three perceived need measures and actual shopping behavior is income dependent. Further investigation revealed that behavior could be differentiated by population sub-segments established on the basis of income level stratification as illustrated in Figure 9.

Probability of Shopping Function

Combining the three elements of perceived need with income stratification produced a function of the type illustrated in Figure 10 relating the probability of shopping for the food product to perceived need and income. This figure specifies the perceived need based function for each of the income levels stratified in Figure 9.

Additional Function Formulation

In a similar manner each decision and response function specification was investigated. In some instances initial theoretical constructs were validated. In others empirical evidence suggesting alternative constructs was obtained and the process of formulation was repeated for revised structures.

Once validated at the function level, decision and response formulations of the type just described are combined in a simulation structure. Operating within the framework supplied by the simulation system, these functions determine the actions and responses of simulated population members.

This stage in the simulation process will be illustrated using output from an appliance market simulation. This system of models was developed following procedures comparable to those just described for the food product. Similar concepts and measures as well as parallel model structure will be evident.

A Week in the Life of a Simulated Consumer

Figure 11 was obtained by monitoring the "thoughts and actions" of one member of a simulated appliance market population during a simulated week in which the population experienced events comparable to those encountered by a real world population during the week beginning February 19, 1962.

Identifying Characteristics

The information provided beginning with the third line of output in Figure 11 identifies characteristic attributes of consumer 109. He is a suburban (SU) resident of New England (NE) between 25 and 35 years of age with an income between $8,000 and $10,000 per year, and has a college education. He presently owns a brand 3 appliance purchased six years earlier.

Consumer 109 presently favors retailers 5, 11, and 3 in that order. He subscribes to or otherwise has available media of types 1, 4, 9, 10, 11, and 12. Media of types 2, 3, 5, 6, 7, 8, and 13 through 24 are not available to him.

Consumer 109's attitudes are summarized in a matrix beginning on line 6 of Figure 11. This matrix indicates his orientation toward 12 product characteristics, 12 appeals, 4 brands, and 18 retailers. From these figures it may be established that the most important (highest attitude) product characteristic insofar as consumer 109 is concerned is characteristic 8 which he regards very highly (+5). Appeals 11 and 4 are similarly indicated as of primary importance to this artificial consumer. From the retailer attitude portion of this matrix his preference for retailers 11 and 5 (both +5 attitudes) and 3 or 16 (both +3 attitudes) may be established. The final entry in the orientation matrix indicates that consumer 109 is aware of brand 1.

Consumer Memory Content

The line stating "MEMORY DUMP FOLLOWS. BRANDS LISTED IN DESCENDING ORDER 1 THROUGH 4" introduces the print-out of consumer 109's present simulated memory content. This memory dump is a record of noted communications retained by the consumer relating specific product characteristics and appeals

to each of four brands. From this report it can be established, for example, that consumer 109 has retained 14 communication exposures associating product characteristic 8 with brand 1, 13 exposures relating product characteristic 8 with brand 2, and 14 exposures associating appeal 7 with brand 3.

Media Exposure and Response

The entry in the report following the memory dump indicates that the segment of the simulation representing media exposure processes has been entered. Six media appear (are published or broadcast) during week 117. Consumer 109 is not exposed to medium 3 since that medium is not available to him (see media availability indicator in the characteristic output). Medium 4 also appears in week 117 and since it is available to consumer 109 he may be exposed to relevant ads appearing in it. The output indicates that he is exposed to an advertisement for brand 3 but does not note that communication. On the other hand an advertisement for brand 4 also present in medium 4 during week 117 is noted as indicated by the line reading, ADVERTISEMENT 19, BRAND 4 NOTED. CONTENT FOLLOWS. The output message then indicates that advertisement 19 contains a high prominence (4) reference to product characteristic 11 and a medium prominence (2) reference to characteristic 4. Advertisement 19 also contains medium prominence references to appeals 5, 7, and 12.

Consumer 109 does not see medium 7 although it appears in week 117, however, he is exposed to three advertisements in medium 12 which also appears during that week. The advertisement for brand 2 is noted while those for brands 3 and 1 are not. Media 16 and 23 also appear in week 117 but are not seen by consumer 109.

Word-of-Mouth Exposure

Report entries following the media exposure section indicate that

consumer 109 is exposed to word-of-mouth comment generated by consumers 93, 104, and 117, but fails to note communication from any of these individuals. Had noting occurred, a message content report comparable to that generated for advertising would have specified the information noted.

Product Experience

Consumer 109 did not have product experience during week 117. Had he made use of the product a report of his response to product use indicating product characteristics or appeals, if any, emphasized by the use experience would have been printed.

Decision to Shop

The next entry in the Figure 11 output indicates that consumer 109 has made an explicit decision to shop; that his highest perceived need is for brand 3; and that his first choice retailer is 5. Simulation models representing in-store experience have been loaded.

In-Store Experience

The first entry within the SHOPPING INITIATED section notes that the consumer is exhibiting behavior associated with the explicit decision to shop option and is seeking brand 3 (there is therefore NO SEARCH activity -- no opportunity for accidental exposure). Simulated retailer 5 is carrying brand 3 therefore consumer 109 finds the brand he is seeking (3).

Retailer 5 has placed point-of-sale display material for brand 3. The consumer is exposed and notes its content emphasizing appeals 3 and 6 and product characteristics 5, 7, 10, and 11 as attributes of brand 3. Retailer 5's simulated salesmen are either not pushing brand 3 or busy with other customers. In any event, consumer 109 is not exposed to selling effort while shopping in retailer outlet 5.

Decision to Purchase

The output statement DECISION TO PURCHASE POSITIVE -- BRAND 03, $38.50, specifies that consumer 109 has made a decision to purchase brand 3 at a price of $38.50. The line following indicates that retailer 5 can make immediate delivery of brand 3.

Response to Purchase

Since consumer 109 has now purchased brand 3 his awareness which was favoring brand 2 is changed to favor brand 3.

Word-of-Mouth Generation

Since consumer 109 is now the proud owner of a brand 3 product, it is not surprising to find him initiating word-of-mouth comment regarding his new purchase. The content of his communication regarding brand 3 emphasizes product characteristics 2 and 8 and appeals 4 and 11 -- the appeals and product characteristics toward which he has the highest perceived brand image as indicated in the previous memory dump.

Forgetting

Consumer 109 did not lose any of his existing memory content during week 117.

The final output line of Figure 11 indicates that consumer 109 has concluded week 117.

Management Use of Simulation Based Systems

As a result of system development activity, management conceptions of market and company environments are systematically tested. In reviewing alternative formulations and evaluating model performance, management must make explicit the normally implicit models on which their decision making is based.

Management participation in the system development process insures that

manager and computer share common perceptions. Models incorporating this mutual understanding become a test market without a memory in which management may examine with impunity the implications of policies and strategies. Whether introducing new products or considering modification of a marketing program, management may apply alternative strategies in the simulated environment and evaluate their implications under various assumed competitive conditions.

The effectiveness of such pretesting is dependent on management's ability to predict probable competitive responses to proposed actions as well as the accuracy of the simulation system. Management may find it profitable to examine the impact of best and worst case competitive response patterns. In most instances the best case assumes that competition will continue with programs developed prior to initiation of company actions. The worst case assumes full competitor knowledge of the proposed company program and combined action to thwart company efforts.

The simulated environment provides the references against which the progress of operations in the real world may be measured. Given a simulation pretest, management can determine by monitoring appropriate variables whether or not a program is progressing as planned. If conditions producing satisfactory performance in the simulated environment are encountered in the real world, it is assumed that final results will be comparable.

Simulation-Based Management Information Systems

Management uses of microanalytic simulation may be summarized with reference to a simulation-based management information system of the type illustrated in Figure 12. Data-gathering procedures are established to generate inputs describing the current state of the market in terms of measures referenced in the simulation structure. These inputs are reviewed and the format set by a preprocessor system before being transferred to the

master data file. The data file serves as the reference source for the information system and provides the historical data base for simulation model initialization.

Management has the ability to interrogate the data file to obtain information regarding the current state of the market. This basic retrieval function is described by the set of interactions noted by A in Figure 12. Management's use of the simulation model as a basis for testing proposed programs is illustrated by the interaction set indicated by B. Proposed plans are input to the information system, which establishes hypothetical conditions for runs of the simulation model. Results obtained in the simulated environment are then transferred to the information system, which formats them for presentation to management. Following this process, management is able to evaluate the conditional results of proposed programs using the same procedures and equipment employed to assess the current state of the market through interrogation.

Once policy and strategy have been finalized, the proposed plan is established as a reference; and simulated measures based on the plan are generated for use by a monitor program. As plans are implemented in the market environment, the monitor program compares actual measures of market performance with simulated measures indicating the expected results of planned implementation. Significant deviation from plan becomes the criterion for monitor referral to management as indicated by C in Figure 12. The information system may be used to evaluate the results of research activities as well as operating plans, as indicated by D.

Management and the Computer

We have been discussing management's role in the development and utilization of systems in which men and machines interact to achieve a higher level of effectiveness measured in terms of criteria specified by management. In

these systems models operating on a computer may perform clerical functions, update and maintain integrated data files containing billions of information elements, evaluate alternative market strategies, coordinate the elements of a planning activity, schedule a program for implementation, monitor the elements of an implemented program, evaluate market response, and refer actionable situations to management.

As the computer assumes these functions, the manager's role must change. The new management role will not involve new or strange activities. It will, however, place a new emphasis on already familiar concerns. Little or no time will be spent in routine analysis, evaluation, or allocation. The procedures to be followed in these "programmable" activities will have been explicitly specified and authority over them delegated to a computer based system. The executive will be concerned with broader policy problems which he will approach with increased effectiveness due to the availability of more meaningful data and increased (model based) understanding of his environment. He will be concerned with problem definition and will devote substantial time to the broader planning functions which are now often relegated to low priority positions on the executive agenda to make way for fire fighting and crisis curtailment. Much of his time will be spent in increasing his understanding of the environment in which his company operates and in refining his insights into the planning and communication processes which are his area of expertise. He will spend substantial time building models -- making explicit, testing, and validating or rejecting hypotheses regarding the nature of his environment and his impact on it.

Freed from many of his present day routine commitments and provided with the ability to study the implications of new concepts and approaches, the executive will have a new freedom to experiment with creative ideas and to

employ imaginative approaches to the formulation and solution of marketing problems.

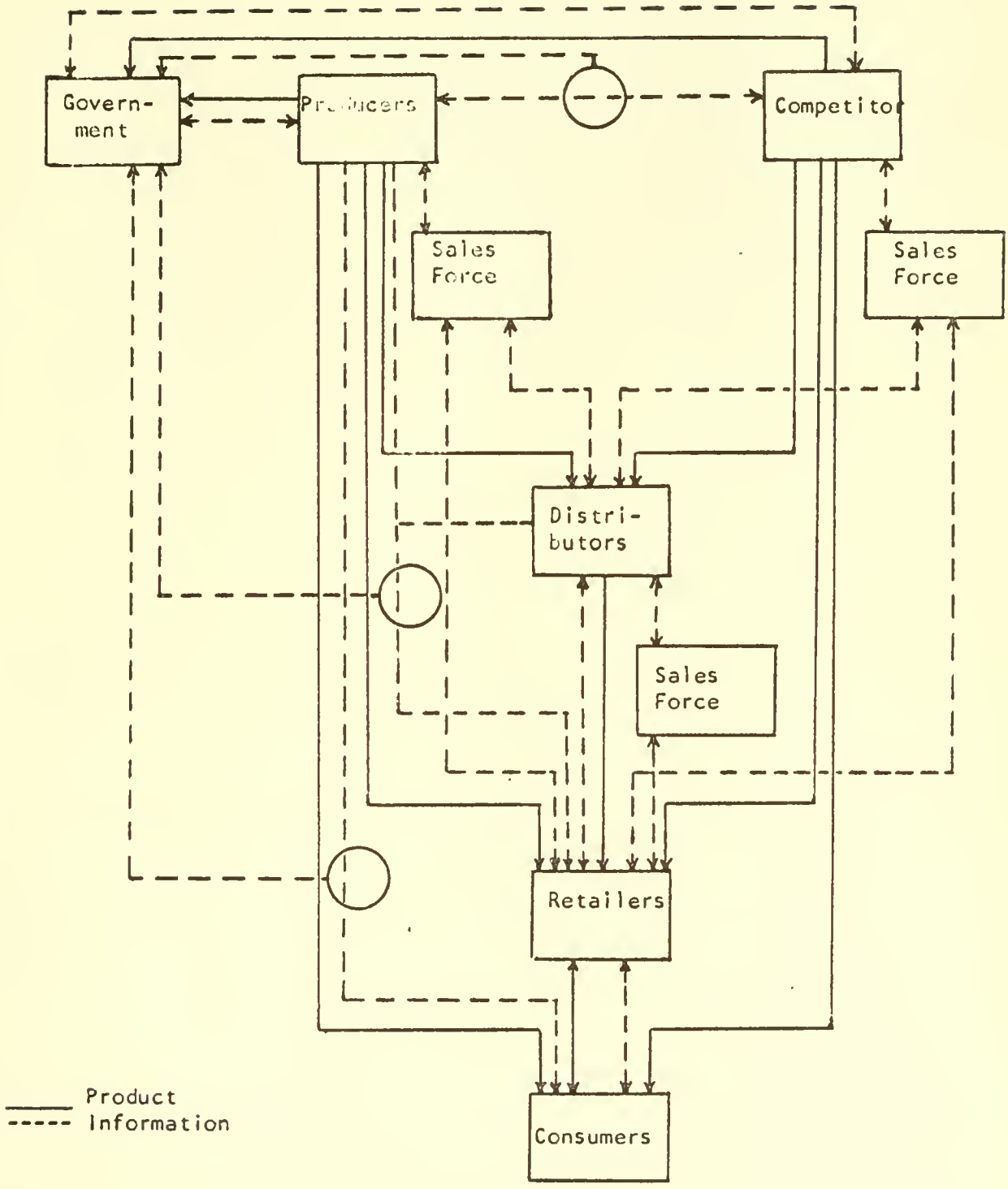


FIGURE . 1

A "MACRO DESCRIPTION"

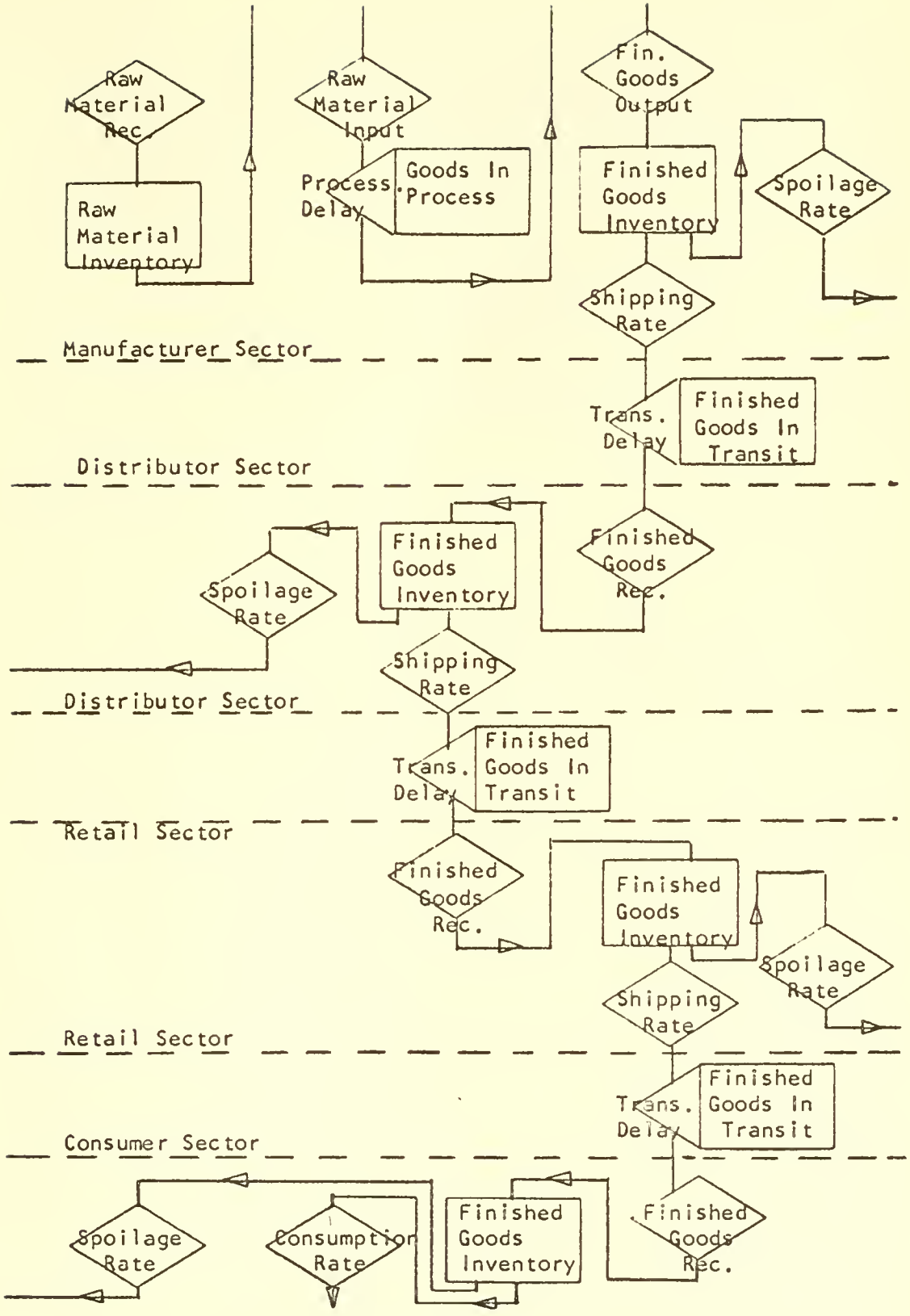


FIGURE 2

MACRO DESCRIPTION OF PRODUCT FLOW BASED PROCESSES

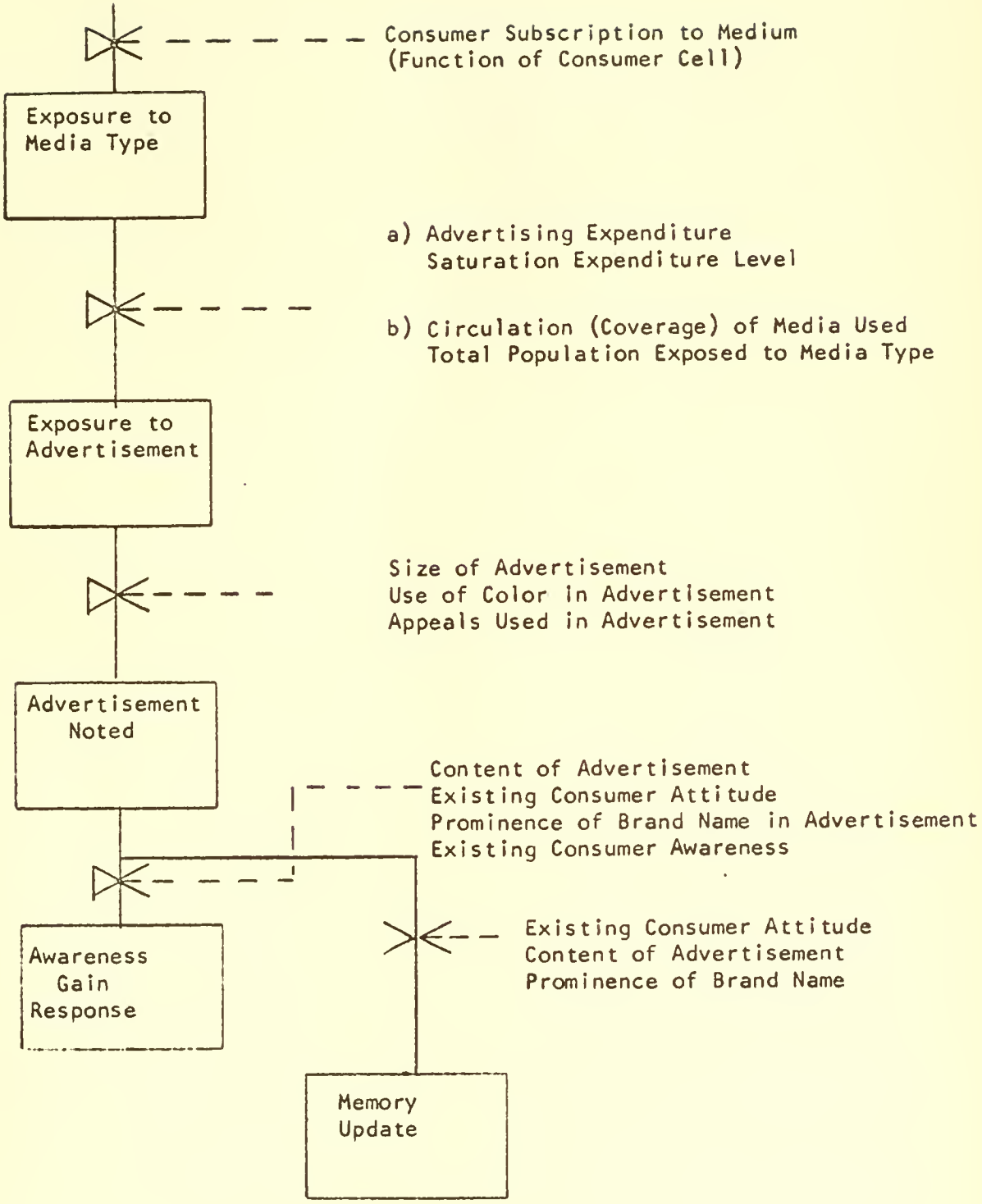


FIGURE 3

ADVERTISING EXPOSURE AND RESPONSE PROCESSES

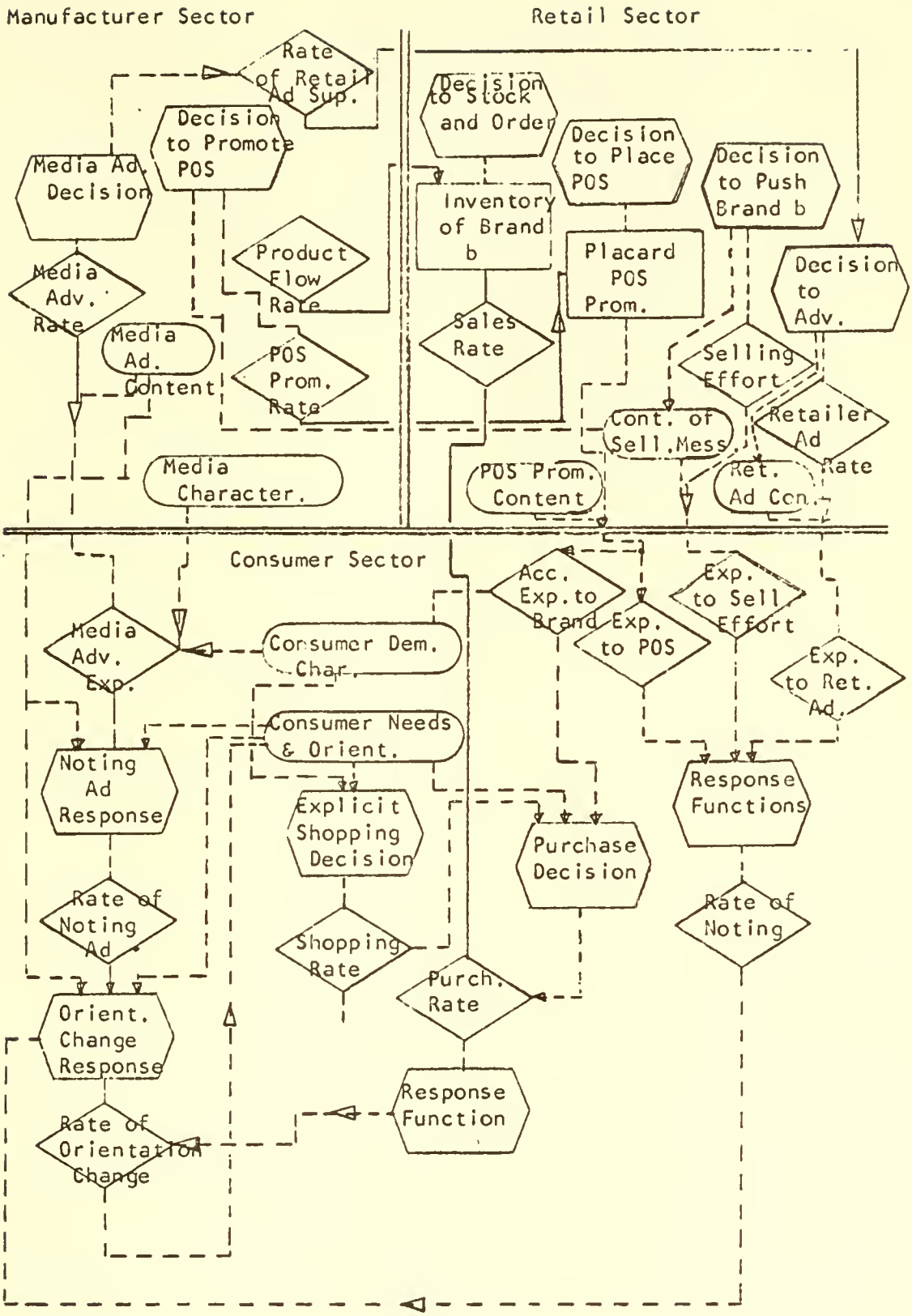


FIGURE 4

DECISION AND RESPONSE FUNCTION SPECIFICATION
FOR THREE MARKET SECTORS

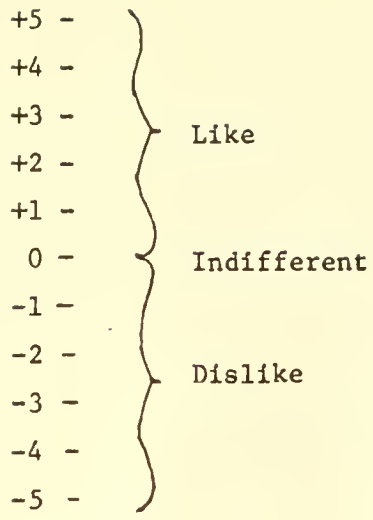


FIGURE 5

THE ATTITUDE SCALE

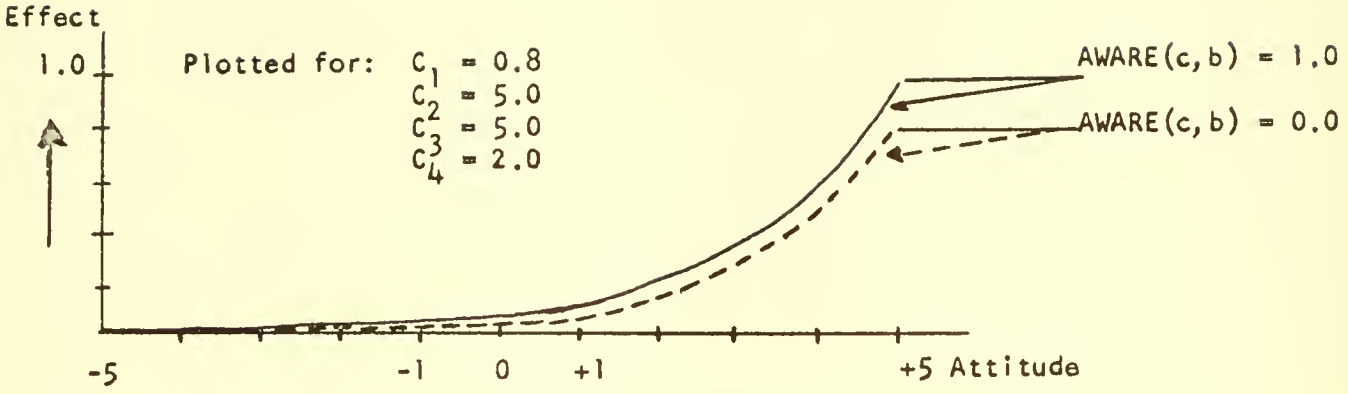


FIGURE 6

EFFECT OF ATTITUDE ON PERCEIVED NEED

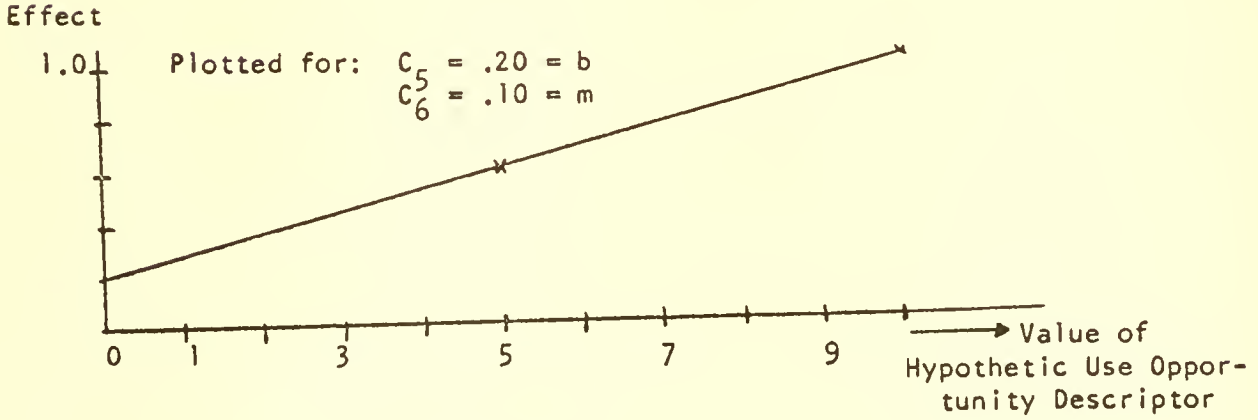


FIGURE 7

EFFECT OF CONSUMER USE OPPORTUNITY ON PERCEIVED NEED

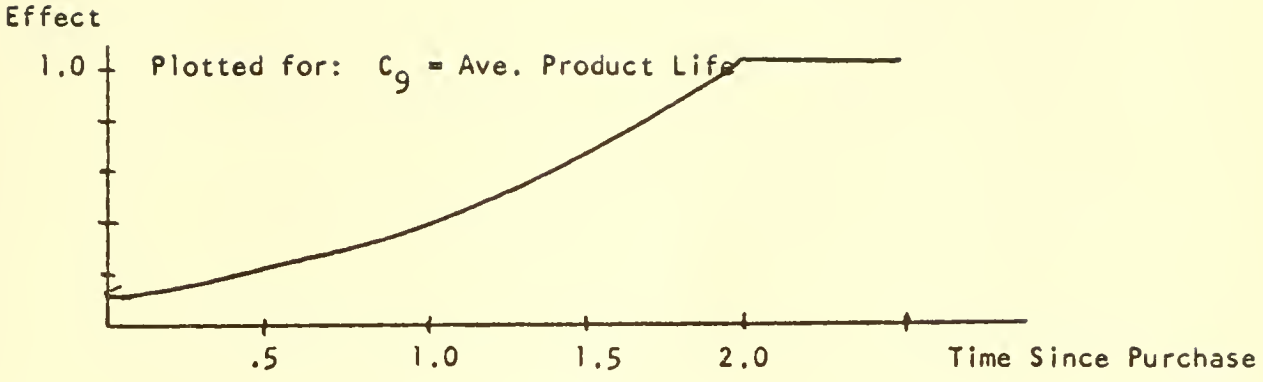


FIGURE 8

EFFECT OF TIME SINCE PURCHASE ON PERCEIVED NEED

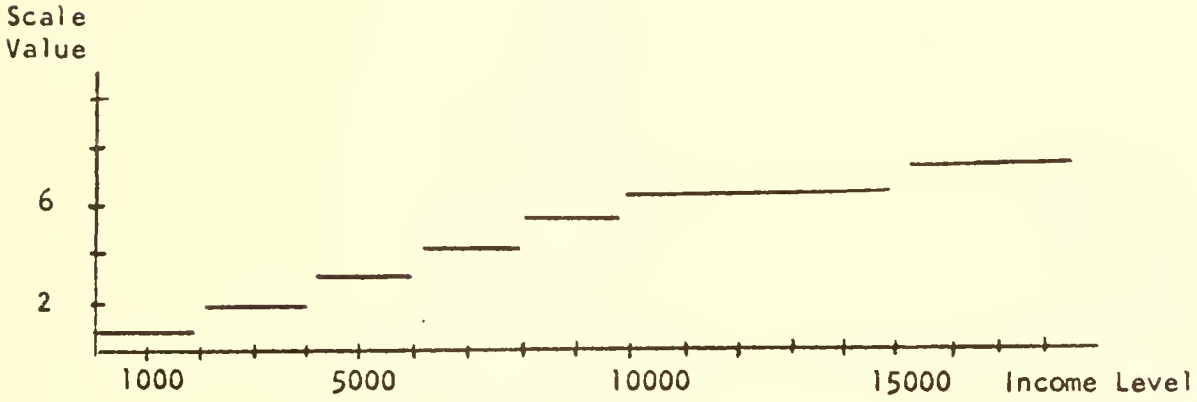


FIGURE 9

SAMPLE INCOME STRATIFICATION

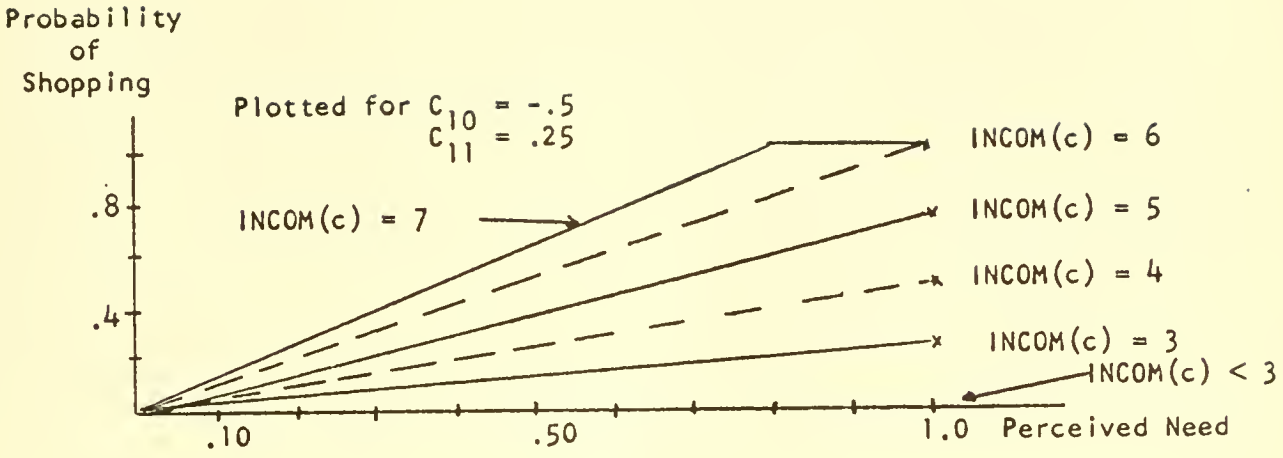


FIGURE 10

PROBABILITY OF SHOPPING AS FUNCTION OF

PERCEIVED NEED AND INCOME

SIMULATION APP-03 TEST RUN APRIL 4, 1965 1400 HOURS

-- CONSUMER 0109 NOW BEGINNING WEEK 117 -- FEBRUARY 19, 1962

- REPORT MONITOR SPECIFIED. TO CANCEL PUSH INTERRUPT.

- CHARAC - REGION NE SU, AGE 25-35, INCOME 8-10K, EDUCATION COLLEG

- BRANDS OWN 3, 6 YEARS OLD. RETAILER PREFERENCE 05, 11, 03

- MEDIA AVAILABLE 1 0 0 1 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0

- ATTITUDES

	1	2	3	4	5	6	7	8	9	10	11	12
PROJ CHAR	0	+1	+1	0	-3	-1	0	+5	0	+3	0	0
APPEALS	-3	0	+1	+5	0	-3	+3	0	0	0	+5	0
BRANDS	+2	+1	+3	+2								
RETAILERS	+1	-5	+3	+1	+5	-5	-5	+1	-1	-3	+5	+1
	-3	+1	-1	+3	+1	+1						
AWARENESS	1	0	0	0								

- MEMORY DUMP FOLLOWS. BRANDS LISTED IN DESCENDING ORDER 1 TO 4

PRODUCT CHARACTERISTIC MEMORY												APPEALS MEMORY										
1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
2	3	15	0	5	5	4	14	8	7	1	3	8	9	7	3	1	11	7	4	4	3	9
8	0	6	4	9	5	4	13	0	3	6	7	6	8	0	7	0	9	2	4	3	10	3
0	6	15	7	0	3	11	3	5	2	5	7	0	4	8	10	9	2	14	3	9	7	9
7	9	3	7	3	2	7	2	6	12	14	2	0	9	7	8	13	9	11	6	0	2	5

- MEDIA EXPOSURE INITIATED

  - MEDIUM 003 APPEARS IN WEEK 117 -- NO EXPOSURES
  - MEDIUM 004 APPEARS IN WEEK 117
    - EXPOSURE TO AD 013, BRAND 3 -- NO NOTING
    - EXPOSURE TO AD 019, BRAND 4
      - AD 019, BRAND 4 NOTED. CONTENT FOLLOWS
      - PROD. C 11 P=4, 4 P=2,
      - APPEALS 5 P=2, 7 P=2, 12 P=2,
  - MEDIUM 007 APPEARS IN WEEK 117 -- NO EXPOSURES
  - MEDIUM 012 APPEARS IN WEEK 117
    - EXPOSURE TO AD 007, BRAND 2
      - AD 007, BRAND 2 NOTED. CONTENT FOLLOWS
      - PROD. C 8 P=3, 12 P=1,
      - APPEALS 2 P=1, 4 P=1, 6 P=1, 10 P=1,
    - EXPOSURE TO AD 013, BRAND 3 -- NO NOTING
    - EXPOSURE TO AD 004, BRAND 1 -- NO NOTING
  - MEDIUM 016 APPEARS IN WEEK 117 -- NO EXPOSURES
  - MEDIUM 023 APPEARS IN WEEK 117 -- NO EXPOSURES

FIGURE 11

SIMULATED APPLIANCE MARKET CONSUMER BEHAVIOR

- WORD OF MOUTH EXPOSURE INITIATED

    - EXPOSURE TO CONSUMER 0093 -- NO NOTING
    - EXPOSURE TO CONSUMER 0104 -- NO NOTING
    - EXPOSURE TO CONSUMER 0117 -- NO NOTING

- NO PRODUCT USE IN WEEK 117

- DECISION TO SHOP POSITIVE -- BRAND 3 HIGH PERCEIVED NEED
    -- RETAILER 05 CHOSEN

- SHOPPING INITIATED

    - CONSUMER DECISION EXPLICIT FOR BRAND 3 -- NO SEARCH
    - PRODUCT EXPOSURE FOR BRAND 3
        - EXPOSURE TO POINT OF SALE 008 FOR BRAND 3
            - POS 008, BRAND 3 NOTED. CONTENT FOLLOWS
            - PROD. C 3 P=4, 6 P=4,
            - APPEALS 5 P=2, 7 P=2, 10 P=2, 11 P=2,
    - NO SELLING EFFORT EXPOSURE IN RETAILER 05

- DECISION TO PURCHASE POSITIVE -- BRAND 3, $ 38.50

    - DELIVERY IMEDAT
    - OWNERSHIP = 3, AWARENESS WAS 2, NOW 3

- WORD OF MOUTH GENERATION INITIATED

    - CONTENT GENERATED, BRAND 3
        - PROD. C 3 P= +15, 8 P=+15,
        - APPEALS 4 P= +50, 11 P=+45

- FORGETTING INITIATED -- NO FORGETTING D

-- CONSUMER 0109 NOW CONCLUDING WEEK 117 -- FEBRUARY 25, 1962

-- CONSUMER 0110 NOW BEGINNING WEEK 117 -- FEBRUARY 19, 1962

QUIT,
R 11,633+4.750

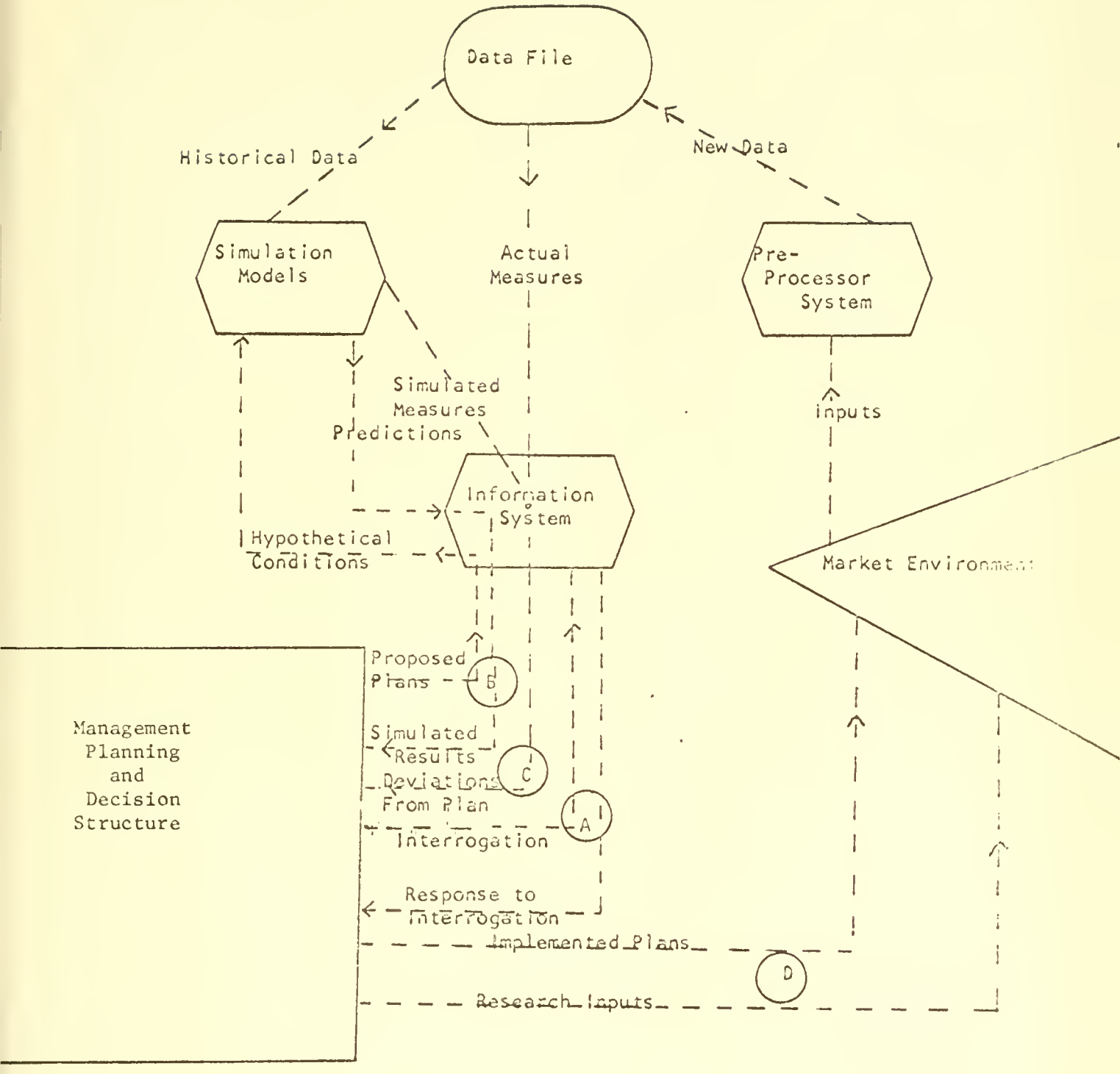


Figure 12

ADAPTIVE SIMULATION BASED MANAGEMENT SYSTEM STRUCTURE

R 14 1968
G 15 1968
T 4 1968

Date Due

[redacted]

JUN 24 '76

OCT 27 '78

MAY 07 '81

MAY 5 '84

Lib-26-67

3 9080 003 900 773

264-67

MIT LIBRARIES
3 9080 003 869 887

265-67

MIT LIBRARIES
3 9080 003 869 838

266-67

HD28 M.I.T.
.M414
Nos.264-67
Nos.273-67 No.

MIT LIBRARIES
3 9080 003 900 799

267-67

MIT LIBRARIES
3 9080 003 869 762

268-67

MIT LIBRARIES
3 9080 003 869 796

269-67

MIT LIBRARIES
3 9080 003 869 770

272-67

MIT LIBRARIES
3 9080 003 900 898

273-67